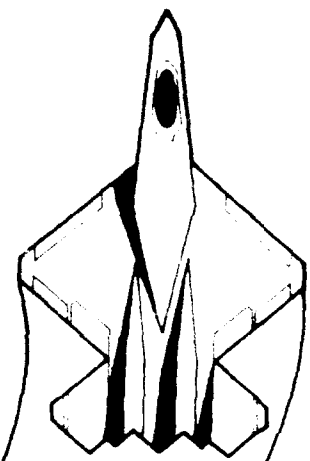

THE FUTURE OF THE AIR FORCE

GEO, LEO, and the Future

RICHARD SZAFRANSKI, Col, USAF

CENTER for AEROSPACE DOCTRINE, RESEARCH and EDUCATION

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by

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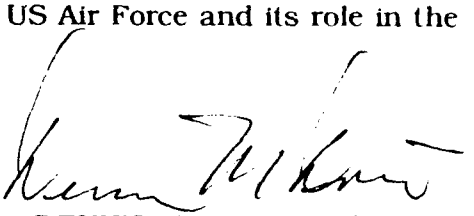
Contents

Foreword

The stunning changes in the complexion of international politics that began late in the decade of the 1980s and continue today will profoundly affect the American military establishment as a whole, and the US Air Force in particular. Decisions about the future course of the military will be made in the early part of the 1990s which will essentially determine the course of the US Air Force well into the next century. Decisions of such importance require thoughtful consideration of all points of view.

This report is one in a special series of CADRE Papers which address many of the issues that decision makers must consider when undertaking such momentous decisions. The list of subjects addressed in this special series is by no means exhaustive, and the treatment of each subject is certainly not definitive. However, the Papers do treat topics of considerable importance to the future of the US Air Force, treat them with care and originality, and provide valuable insights.

We believe this special series of CADRE Papers can be of considerable value to policymakers at all levels as they plan for the US Air Force and its role in the so-called postcontainment environment.



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Executive Summary

The United States is clearly a space-faring nation. We are, and will likely remain, a superior aerospace power. At the same time, space systems continue to proliferate in other countries. The impact of this proliferation on US security depends upon how well and how soon other nations understand the potential of space systems and upon the degree and purposes to which they exploit the technology.

In all likelihood, spacepower will prove decisive in future combat. Accordingly, we must continually assess the impact of foreign space systems on present and future military operations. We must also look for ways to enhance the US defense posture by improving our own space doctrine and technology.

Space systems in geostationary or geosynchronous orbit will play key roles in deterring nuclear war and in deterring or preventing other forms of aggression against the United States and her allies. These systems will also play important roles in resolving conflicts that cannot be prevented. Space-based surveillance, communications, and navigation systems will make it easier to see, move, talk, and shoot. In the future, space-based systems, possibly in combination with smart, long-range standoff weapons, will provide both target acquisition and terminal guidance for precision-guided munitions. Combining the positional capabilities of navigation satellites with the relay capabilities of communications satellites will greatly facilitate such operations as airborne or ground rendezvous, air intercepts, cargo drops, and search and rescue.

Space-based systems can be used to support the internal defense and development strategies of developing nations. In addition to determining the position, disposition, and intentions of hostile forces, space systems can enhance nation-building efforts through meteorology, cartography, earth-resources sensing, computational assistance, and educational networks.

Exploiting the full potential of space technology requires, in addition to the systems themselves, adequate budgets and a firm doctrinal foundation for employing spacepower, both independently and in concert with other military operations. The more thorough our understanding of how space operations can contribute to deterrence and crisis resolution, and the more rapidly we assimilate space capabilities into our plans and operations, the more we will be able to help the Air Force serve our nation and its global interests.

Introduction

WHEN I LAST was there, adorning the walls of the foyer of Air Force Space Command headquarters were two quotes attributed to former Air Force chief of staff Gen Larry D. Welch. One asserted that "spacepower will be as decisive in future combat as airpower is today." The other that, "The future of the Air Force is inextricably tied to space."

If General Welch is correct, space systems in geostationary or geosynchronous earth orbit (GEO) and low earth orbit (LEO) will be important to the deterrence or resolution of future conflicts. How important they will be depends both on how well the existing and potential contributions of space systems are understood and on the degree to which nations exploit these contributions.

Space systems—ours and those of other nations—will continue to proliferate. Consequently, those people charged with providing for national security are obligated to assess the impact of space capabilities on present and future military operations. Scanning the entire operational continuum, the airman's handbook for future operations should include a handful of space tenets.

Space Systems Help Deter Conflict

UNTIL the arrival of *perestroika*, the United States has tended to focus on deterrence almost exclusively in terms of nuclear deterrence. Although the task of deterring nuclear war will always be our first national security priority, deterring or preventing other forms of aggression against the United States and our allies must also be a goal. In most cases deterring conflict on our terms is a superior alternative to killing and dying. Sun Tzu observed that the most skillful warriors can defeat an enemy without actually going to war.

Space systems help deter conflict by providing information about the world beneath them. Information is, or can be, knowledge. Timely information can allow us to take diplomatic initiatives that might prevent conflict. Similarly, information can be an important tool or lever in the continual power-balancing process that an increasingly multipolar world requires.

Space Systems' Effect on the Warrior's Burdens

IN spite of our best efforts to deter aggression, we may have to fight. Space-based surveillance, navigation, and communication systems can make it easier to see, move, talk, and shoot. But in the future those advantages could pertain to both sides involved in a conflict.

Surveillance systems can render large portions of the earth's surface (and even the ocean and land subsurface to some depth) transparent. As sensor technology exploits more of the electromagnetic spectrum, the ability to assemble and move covertly becomes increasingly threatened. Concealment—including the entire gamut of signature reduction techniques—must become a routine part of operations from assembly through employment. Operating in darkness

provides some advantages, but radars and infrared systems can "see" even in the dark. It would be wise to incorporate stealth and signature-reduction technologies in every way feasible. Without an awareness of space-based surveillance capabilities, we may be unable to employ surprise to our advantage. Worse, we may ourselves be surprised.

Thus, we need to know the types of space-based sensing systems or data to which an adversary may have access, when these systems may be overhead, their fields of view, and how they best can be defeated or degraded. Naval forces—scrutinized for years by Soviet radar ocean reconnaissance satellites (RORSAT) and electronic intelligence ocean reconnaissance satellites (EORSAT)—are already able to conduct operations in ways that make sensing by hostile satellites more difficult. Air forces, except for special operations air components, are somewhat less experienced at incorporating passive countermeasures against sensing satellites.

Eventually, we may have to accept that an adversary may be able to see or hear us, but we can still degrade the utility of that sensed information. For example, the probability of detecting a small force is lower than the probability of detecting a large force. Nonetheless, we can assemble a large, combined force by generating small portions of it at a time, by originating from widely separated geographical points and rendezvousing in the air or on the ocean, or by operating at a tempo that exceeds the adversary's data distribution or decision capability. What technology allows, tactics or operational art may be able to defeat.

We must remember that a target country need not "own" surveillance satellites to have access to the data a satellite can provide. Spacecraft, launch vehicles, and launch operations are all relatively complex and expensive, and are likely to remain so. Each global positioning system (GPS) satellite costs $43 million, and each GPS satellite launch costs another $50 million. Those nations that are technologically capable of spacefaring oftentimes offset their investment costs by marketing "the take" from their spacecraft. For example, images taken by the French *satellite pour l'observation de la terre* (SPOT) and planned heteropowered earth-launched inter-orbital spacecraft (HELIOS) are and may be commodities for sale. News services increase their effectiveness by employing space systems to transmit voice, text, and pictures. In the future, news services may also employ a low resolution imaging satellite (already nicknamed MEDIASAT) with multiple subscribers. Equally important are the potential impacts of sharing the air, sea, and land battlefield with evening news crews on both sides of our gun barrels.

A routine part of the intelligence preparation of future battlefields at any anticipated level of intensity should include the notation of the space-derived data to which the adversary (or the press) has, or might have access. Depending on their objectives, inclinations, and capabilities, third-party nations might find it advantageous to provide space-derived information to our adversaries in future crises.

Combatant commanders, joint task force (JTF) commanders, and air component commanders must be aware of friendly and adversarial space capabilities. The tactical exploitation of national capabilities program (TENCAP) provides access to a broad range of friendly surveillance capabilities. Nonetheless, the intelligence staff still must ascertain the adversary's ability to use space

against us, and the operations staff (including communications-electronics personnel) must acquire access to the space-based navigation and communication systems necessary to enhance operations.

These liaison requirements could be simpler. In our gratuitous rush to "jointness" in 1985, the Department of Defense (DOD) created the unified United States Space Command (USSPACECOM) by appending a comparatively small Naval Space Command and a minuscule (and unofficial) Army Space Agency to an already large and robust Air Force Space Command. A joint headquarters staff was added to manage the USSPACECOM. About 90 percent of the forces assigned to the United States Space Command belong to, and are operated by, the Air Force component. Whatever value jointness adds may not ameliorate the disadvantages that the existing architecture presents to air component commanders serving other war-fighting commanders in chief.

For example, the air components of the Pacific, Atlantic, Central, and European Commands are "air only" commands. Thus, whatever "space" expertise the combatant commanders require is not brought to them by their air component commanders. Rather, the staff or functional cells of a supporting "space-CINC" provide this expertise.

We might have avoided this diminution of the air component commanders' responsibilities, along with the fracturing of aerospace support, by making the Air Force Space Command a specified command for space operations. Today, however, the supported CINC must get the space support required by means of liaison with another CINC, his own TENCAP staff, or—depending on the inclinations or uniform of the supported CINC—the Army, Navy, or Air Force Space Commands. The DOD eventually must weigh the advantages of having another unified command for space and its associated joint headquarters staff (all to manage a force structure largely Air Force in origin) against the dilution of aerospace support and the cost and effectiveness penalties this imposes. Although the issue is settled for the moment, unless the other services increase their investment in space operations, this issue will reemerge in the future. As the unified and specified command structure responds to fiscal realities and changes in the threat, the necessity to reorganize can become a virtue. Airmen who fail to recognize that "space power" is the deliberate evolution of "airpower" have failed to comprehend the inevitable progression of armaments entering the next millennium.

Space-based systems can provide a multitude of data—the raw material of space power—but only human cognition and human manipulation can turn data into operationally useful information. One positive outcome of creating the transitional architecture of a unified space command and the associated push for jointness has been a dramatic increase in military space expertise. The services are simultaneously pursuing three important management goals: (1) to acquaint space specialists with specialists from other branches and communities of combat arms, (2) to educate military leaders at intermediate and senior service schools on the contributions space systems can make to deterrence and war fighting, and (3) to ensure that space system end-user requirements—including products—are defined more clearly by the operational user.

Until recently, engineers, communications-electronics specialists, intelligence officers, and the research and development community have dominated military space forces at company grade and lower-level field grades. In the past, operators from the traditional land, sea, and air warfare specialties did not fully

capitalize on space-derived data. As a consequence, space-based capabilities have evolved at a rate greater than the capabilities of the distribution and dissemination systems that provide space-derived information to military users. Educated combatants are becoming more articulate in specifying what they want, how they want it, the rate and speed required, and the operational impact of failing to satisfy these requirements. Even in the unlikely event that space-based systems and architectures remain largely static, combatants can expect to see exponential improvements in the quality, speed, and specificity of the space-derived information they receive.

Space Systems Can Help Simplify Complex Operations

NAVIGATION satellites like the global positioning system eventually will provide coverage of the entire earth. The ability of friendly forces to fix their positions within feet and to accurately determine speed and course to the next point provides tremendous advantages. These advantages facilitate airborne or ground rendezvous, air intercepts, cargo or troop drops, weapon delivery, obstacle breaching, minesweeping, and search and rescue operations.

Communications satellites allow voice (including secure voice), data, and facsimile transmission without reliance on a large, deployed, ground-based equipment infrastructure. Technological advances, including greater miniaturization, may make it possible to combine the positional capabilities of navigation satellites with the relay capabilities of communications satellites, eventually allowing accurate fixing of friendly forces of squad size without any effort beyond depressing a single key. Before long that same squad can receive an up-to-date facsimile image of what lies ahead of it, even while it is in contact with the enemy. In addition to supporting military operations for conventional war, space-based navigation, surveillance, and low-probability-of-intercept communications systems will add even greater leverage to friendly forces engaged in counterterrorism, counternarcotics, peacekeeping operations, and operations to restore order.

Space-Based Systems Will Revolutionize Precision-Guided Munitions

EVOLVING sensor technology will result in an increasing number of targets that can be seen from space. Combining the ability to acquire targets with accurate position information and long-range standoff weapons will allow a wide range of semiautonomous weaponry. Today, either the delivery platform, the weapon itself, or a ground-based target designator provides terminal guidance. Tomorrow, space platforms commanding the high ground of GEO or LEO can provide terminal guidance. Reconnaissance-strike complexes, as some call them, are a likely technological spin-off of Strategic Defense Initiative (SDI) research.

Ultimately our ability to assimilate capabilities into our doctrine and budgets, and *not* technology, will determine the limits of precision-guided munitions. Although many air operations will continue to require that we endanger human beings flying manned systems, many more operations will not. Space systems can combine with smart, long-range standoff weapons to greatly extend the range and capabilities of airpower application. Space systems can provide the culmination of the trend begun in World War II with Germany's V-1 and V-2 strategic bombardment weapons.

Cruise missiles, the over-the-horizon advanced medium-range air-to-air mis-

sile (AMRAAM), the HAVE NAP (a conventional, imaging, infrared-seeker missile), the TACIT RAINBOW (a conventional, loitering, antiradiation missile), and an entire class of remotely piloted vehicles lack only longer range and real-time links with space systems to complete a trend begun almost half a century ago. Although traditional thinking seems to require that we remain wedded to manned aerospace systems, it is not obvious that manned systems are superior for many missions to unmanned ones in exploiting the full range of the aerospace. Just as advocates of the horse cavalry resisted the assimilation of aircraft into the army, existing air forces might resist the greater assimilation of unmanned systems into airpower. For example, senior airpower decision makers may soon have to decide whether the national security is better served by "too-few" B-2s or "just enough" reconnaissance-strike complexes.

Nonetheless, space systems and long-range unmanned weapons or engagement systems likely provide potential solutions to many of the problems posed by relocatable targets, the air defense of carrier battle groups, offensive and defensive counterair operations, and offensive air support operations. Linking space-based surveillance and navigation systems with long-range unmanned weapons extends the range, speed, and surprise of lethal air operations. Moreover, such linkages can increase the survivability of friendly air forces by increasing their displacement from the lethal engagement envelope of enemy systems. Eliminating the human "pucker factor" can also increase the precision or discrimination of force application.

Minimizing collateral damage is a requirement that will dominate all future contingencies and combat operations. Low-tech weapons rarely assure the precise application of force. The ultimate in high tech on battlefields of the future may be the offspring of a marriage between space systems and long-range precision-guided munitions. Most likely the future will allow us to contemplate space-to-earth weapons.

Space-Based Systems Can Support Developing Nations

IN addition to helping foreign friends and allies detect, deter, and, if necessary, counter external threats, space-based systems can be used to support the internal defense and development strategies of developing nations. As an aid in countering various forms of subversion, lawlessness, and insurgency, for example, satellite surveillance and communications systems can all play important roles in determining the position, disposition, and intentions of hostile forces. One of the most promising applications of space systems in the developing world, however, is nation building.

Space systems have revolutionized meteorology, cartography, and earth-resources sensing. Predictions of crop yield, determination of the migration or extent of pest infestation, forecasting of droughts, identification of potential growing areas and water sources, and the selection of lucrative oil or mineral exploration areas are all facilitated by our space-based capabilities. Each of these capabilities can make an invaluable contribution to a developing nation. No other nation on the planet possesses the equal of our space-based capabilities.

Moreover, our global communications capabilities allow us to provide a friendly third-world nation with such things as classroom instruction, medical diagnoses, technical training (including some of the general or specialized training required for military personnel and police forces), business management advice, and even entire newspapers—all via satellite. In the future, lower cost videoconferencing, computational

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capabilities, and over-the-shoulder assistance with medical procedures all will be possible using space-based systems. All these capabilities constitute a unique kind of aid we might provide to friendly developing nations.

Space-Based Systems and Capabilities May Become Targets

WHATEVER other characteristics one might ascribe to our nation—a democratic power, a maritime trading nation, and so forth—we are and are likely to remain a technologically superior aerospace power. Such a power would be wise to protect the space forces it has and the ones it will acquire. Although the then-commander in chief of the United States Space Command, Gen John L. Piotrowski, valued our space infrastructure at over $400 billion in 1988, our nation still lacks an antisatellite system to defend its assets in orbit and to engage the space-based systems an adversary can employ against us.

Ballistic missiles are proliferating, even in the third world. Many of these systems have the "reach" necessary to engage targets in low earth orbit. While ballistic missile technology and ground-based antisatellite technology are not the same, in some nations—Israel, France, or the United Kingdom perhaps—one technology might eventually beget the other. Without trivializing the technological challenge posed by antisatellite operations, we can say that any nation that has a space surveillance capability, a direct ascent weapon or jammer, and the will to employ these systems in an antisatellite role could constitute a threat.

Since our space systems provide such great advantages, an adversary would most likely find them lucrative targets for attack. Either the space-based segment of a system, the ground-based segment, or the electronic connectivity between the two can be the object of attack. Of the three elements comprising the system, the ground-based elements are perhaps the most vulnerable.

We should no longer think of ground-based down-link sites, processing centers, and distribution networks—even those in the continental United States—as safe from attack. Terrorist forces, drug cartels, and the irregular or forward deployed forces of hostile third-world nations are each capable of destroying or degrading our relatively soft, ground-based space support infrastructure. Hostile groups might mount attacks as reprisals or as denial operations.

Likewise, in the future we may find it necessary or advantageous to disrupt or destroy the space-based communications or surveillance capabilities of another nation. Electronic attacks (including jamming or intrusion), soft kill of spacecraft, or reciprocal operations against an adversary's ground-based architecture are all candidates.

Conclusion

IF we are to be adequately prepared for the future, our lexicon must also include an understanding of those acronyms, GEO and LEO. Although the seat or purpose for military operations will remain on the earth, space operations will become increasingly important to the outcome of land campaigns (and their supporting naval and air campaigns) at every level of conflict intensity. The more thorough our understanding of the contributions that space systems make to deterrence and crisis resolution, and the more rapidly we assimilate space capabilities into plans and operations, the more able we will be to serve our Air Force as its airpower serves our nation and its global interests.